SCIENCE

VOL. 100 FRIDAY, SEPTEMBER 1, 1944 No. 2592

SCIENCE: A Weekly Journal devoted to the Advancement of Science. Editorial communications should be sent to the editors of SCIENCE, Lancaster, Pa. Published every Friday by

THE SCIENCE PRESS

Lancaster, Pennsylvania

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington 25, D. C.

LIVING FOSSILS

By DR. DOUGLAS H. CAMPBELL

STANFORD UNIVERSITY

THE simplest organisms, like bacteria and many protozoa and unicellular fresh-water green algae, probably have changed but little during the ages that have intervened since they first came into existence, as their aquatic environment has remained much the same.

A study of the fossil record indicates a similar conservatism in the land plants, including the angiospermous flowering plants, whose earliest known fossil remains from the Cretaceous belong to genera still existing. Of course they must have been preceded by earlier Mesozoic types, but as yet these are unknown.

The importance of fossils, both plant and animals, as indicators in geologieal formations is of course recognized, but the tendency to emphasize the greater importance of animal fossils might perhaps be questioned.

The fossils of the late Mesozoic and early Tertiary are especially important, since it was in these eras that the origin and evolution of the now dominant angiosperms and mammalia were inaugurated.

Many common American trees, like the sycamore, oak, elm, willow, beech, tulip-tree (*Liriodendron*) and others, are found in the Cretaceous, and it is probable that the forests of the Cretaceous and early Tertiary were not very different from those of the present eastern United States. Since these trees have remained practically unchanged since the late Mesozoic to the present time, they might be termed "living fossils."

The animal life, however, has altered radically. The dinosaurs, which reached their culmination in the Jurassic and Cretaceous, have given way completely to the mammals which at the period of the dinosaur

dominance were apparently insignificant creatures whose fossil remains are relatively rare and whose relationships are uncertain.

Plant fossils, however, sometimes occur in great abundance, both as petrifactions, like fossil wood, or as leaf prints, which often are as clear as photographs from living leaves, and often may be referred to existing genera, *e.g.*, *Platanus, Juglans, Liriodendron, Sassafras.*

The earliest land plants were probably small thallose forms like some of the simplest living liverworts (Hepaticae). Very few fossil hepaticae have been described, but they must have existed during the Paleozoic era. It is probable that a careful search would show spores which might be referred to hepaticae. The discovery of fossil spores in the Upper Cambrian[1] is the earliest known example of what may have been a terrestrial plant, possibly an amphibious liverwort, like the living *Ricciocarpus.* The structure of these Cambrian spores indicated they were formed in tetrads, like the spores of all land plants from the simplest liverwort to the most specialized flowering plant. The pollen spores are strictly homologous with spore-tetrads of the liverworts.

The earliest vascular plants that have been definitely recognized occur in the Devonian. Especially noteworthy are the Rhyniaceae, first described by Kidston and Lang[2] from the Middle Devonian of Scotland. The Rhyniaceae were very primitive plants without definite leaves or roots. In the later Devonian and Carboniferous were many types evidently related to the existing pteridophytes, *i.e.*, ferns, lycopods and horsetails (Equisetineae) some of which developed simple seeds.

Finally in the late Carboniferous or Permian, true seed-plants, some of which were related to the conifers and cycads, occur, and these gymnosperms became extensively developed in the Mesozoic. During the Mesozoic there was a marked development of the Cycadeoideae—cycad-like plants, some of which may possibly have anticipated the first angiosperms.

The latter part of the Mesozoic era marked one of the great geological revolutions, the Laramid Revolution, when there were extensive invasions by the sea and violent volcanic activity; and it was also a period of active mountain building, and probably marked movements of land masses—perhaps including continental drifting. Du Toit[3] believes that extensive continental drift—especially in the southern hemisphere—began in the late Mesozoic. The Cretaceous marks the beginning of a new era in the evolution of both plant and animal life. The two now dominant plant and animal groups—angiosperms and mammals, are first noted in the late Mesozoic.

All typical plants, from the microscopic unicellular alga to the 300-foot redwood, depend for their existence on the photosynthetic activity of their green cells. The chlorophyll tissue in the more specialized forms is segregated in a special organ, the leaf. In the flowering plants, especially the dicotyledons, the leaf, with its firm epidermis and framework of woody veins, is resistant to decay and the fossil leaf prints might have been made from living leaves—as they can often be referred to living genera. There seems to have been no essential change in leaf structure from the earliest Cretaceous dicotyledons to that of their living descendants.

Plants being incapable of locomotion, their migration must have been very gradual, and where either as fossils or living species, the same forms occur in widely separated regions, *e.g.*, Brazil and Equatorial West Africa, it must be assumed that these regions must sometime have been in direct contact; hence the importance of plant fossils as geological indicators. It is true that there are special instances of the rapid distribution of the seeds or fruits of certain plants by animals or by wind or water currents. These cases are exceptional and quite inadequate for transfer over such barriers as the oceans or high mountains.

While the fossil record, especially in the southern continents, is still very incomplete, it is clear that the fossils are closely related to existing species of the same areas, and there is no intrusion of alien genera. Thus the fossils of the temperate zones of North and South America are essentially different. For example, the great order of conifers, so conspicuous a feature of the North Temperate Zone, has no northern genera represented in the South Temperate where the familiar pines, firs, cedars, etc., are replaced by the austral genera, *Araucaria, Podocarpus, Fitzroya,* etc., quite unknown in North America. There is also complete absence in South America of the common North American trees, *e.g.*, oaks, elms, maples, beech, chestnut, magnolia and many others. This essential difference in the temperate floras of the two continents and the fact that most of the existing forms can be traced back to the end of the Mesozoic era, is a strong confirmation of the recent theory of Du Toit—that there were two primordial continents, Gondwana and Laurasia, which remained completely separated until the end of the Mesozoic, when Gondwana divided into the present southern continents, which drifted apart to their present positions, carrying with them many of the unchanged descendants of the original Gondwana flora.

The existing remnants of the Gondwana flora occur in regions separated by vast expanses of ocean. There are many instances among the so-called sub-Antarctic

[1] W. C. Darrah, SCIENCE, 86: August, 1937.
[2] R. Kidston and W. H. Lang, *Trans. Roy. Soc. Edinb.*, 1–5, 1917–1921.
[3] A. L. Du Toit, "Our Wandering Continents," London, 1937.

floras of common genera in New Zealand, Tasmania and Southern Chile, and between Brazil and Equatorial West Africa are numerous common tropical genera and even species. Perhaps most remarkable is the presence in South America of two species of *Araucaria*, primitive conifers, found elsewhere only in Australia.

Du Toit's theory of Continental Drift is the only plausible explanation of the present distribution of plants, especially in the Southern Hemisphere.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FINAL REPORT ON THE REVISION OF THE CONSTITUTION BY THE SPECIAL COMMITTEE ON REVISION OF CONSTITUTION AND BYLAWS

YOUR special committee on revision of the Constitution and Bylaws submits herewith a proposal for a new Constitution. This document is the result of long-continued study, which began in 1939.

The committee first consisted of Livingston, Long and Moulton. Dr. Long resigned in 1942 because of pressing duties connected with national defense and the war. The Executive Committee accepted his resignation with regret and subsequently named Dr. O. W. Caldwell to succeed him. Throughout its long period of study, the special committee has held many sessions and has employed both correspondence and consultation by telephone. Many suggestions and proposals have been received and considered, some of which were brought forward by members of the Secretaries' Conference at its Dallas session.

In submitting this report, your special committee formally moves:

1. That the Executive Committee accept the report and instruct the special committee to submit a later report on the revision of the Bylaws.

2. That the Executive Committee approve the proposed new Constitution and refer it to the Council for action at the approaching Cleveland meeting of the Association.

3. That the Executive Committee recommend to the Council that the proposed new Constitution be presented at a general session of the approaching Cleveland meeting, with the Council's recommendation that it be adopted as an amendment to the Constitution of 1919, according to the provisions of Article Eleven of that Constitution.

Respectfully submitted,

BURTON E. LIVINGSTON, *Chairman*
O. W. CALDWELL
F. R. MOULTON

July 24, 1944

Unanimously approved by the Executive Committee at a meeting held August 6, 1944.

REVISED CONSTITUTION

ARTICLE I—OBJECTS

The objects of the American Association for the Advancement of Science are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress. The Association is a non-profit scientific and educational organization. It aims to conduct meetings and conferences of those interested in the various branches of science and education, to produce and distribute publications, to administer gifts and bequests as prescribed by the donors thereof, to provide support for research, to arrange awards for the accomplishment of scientific work, to cooperate with other organizations in the advancement of science and to engage in such other activities as shall have been authorized by the Council.

ARTICLE II—MEMBERS

Section 1. The membership of the Association shall consist of Annual Members, Life Members, Sustaining Members, Honorary Members and Emeritus Members. Admission to each of these five classes of membership shall be in accordance with the provisions of Section 2 of this Article and with such relevant rules as the Council shall have prescribed. The Council may establish additional classes of membership.

Section 2 (a). *Annual Members.* Any person, institution or organization may be admitted to annual membership. Each Annual Member shall have such rights and privileges and shall pay such annual dues as the Council shall have prescribed.

(b). *Life Members.* Any person making to the Trust Funds of the Association a life-membership contribution of such amount as the Council shall have prescribed may be admitted to life membership. Each Life Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

(c). *Sustaining Members.* Any person making to the Trust Funds of the Association a sustaining-membership contribution of such amount as the Council shall have prescribed shall be the founder of a Sustaining Membership, which shall bear his name and shall be maintained in perpetuity as a trust. Each incumbent of a sustaining membership shall have all the privileges of a life member. The first incumbent of a sustaining membership may be either the founder himself or another person named by him, as he may choose. On the death or resignation of an incumbent, the Executive Committee shall name another person to hold the membership throughout life.

(d). *Honorary Members.* Any person may be admitted to honorary membership under such conditions as the Council shall have prescribed. Each Honorary Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

(e). *Emeritus Members.* Any individual annual member may be admitted to emeritus membership under such conditions as the Council shall have prescribed. Each Emeritus Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

Section 3. Fellows. Any person who shall have made a meritorious contribution to science may become a Fellow of the Association, under such procedures for nomination and election as the Council shall have prescribed.

ARTICLE III—OFFICERS

Section 1. The officers of the Association shall be (a) General Officers, elected from among the Fellows by ballot of the Council, and (b) Administrative Officers, elected by the Executive Committee as prescribed in Section 3 of this Article.

Section 2. General Officers. The general officers of the Association shall be a President Elect, a President, a Retiring President, and a Vice President for each Section. The term of office of the general officers shall be one year. The term of office of the President Elect and of the Vice Presidents shall begin on the January fifteenth following their election. At the close of the one-year term of the President Elect he shall become President, and at the close of the one-year term of the President he shall become Retiring President. In the event of a vacancy in the office of President, the President Elect shall become President. In the event of a vacancy in the office of President Elect, the Executive Committee shall make a *pro tempore* appointment to hold until the vacancy shall have been filled by ballot of the Council. In the event of a vacancy in the office of Vice President, the Executive Committee shall fill the vacancy by appointment.

Section 3. Administrative Officers. The administrative officers shall be an Administrative Secretary, an Assistant Administrative Secretary, a General Secretary, a Treasurer, and a Secretary of each Section. The term of office of each administrative officer shall be four years, or a shorter term if so determined by the Executive Committee. Unless otherwise determined at the time of his election, his term shall begin on the January fifteenth following his election. The Administrative Secretary, the Assistant Administrative Secretary, the General Secretary and the Treasurer shall be elected by the Executive Committee. The Secretaries of the Sections shall be nominated from among the Fellows by the respective Section Committees and elected by the Executive Committee. In the event of a vacancy in the office of an administrative officer, the Executive Committee shall fill the vacancy for the remainder of the unexpired term. Additional administrative officers may be authorized by the Council, to be elected or appointed according to such rules and for such terms as the Council shall have determined in each instance.

ARTICLE IV—COUNCIL

Section 1. Control of all affairs of the Association is vested in the Council, which shall have power to review and to amend or rescind its own actions and all actions taken by the Executive Committee or by other agents to whom powers are delegated by this Constitution or shall have been delegated by the Council. The Council shall enact such bylaws as it may deem desirable, each of which shall remain in force until amended or rescinded by action of the Council.

Section 2. The Council shall consist of (a) the President Elect, the President, the Retiring President, the Vice Presidents, the Secretaries of the Sections, the Administrative Secretary, the General Secretary, the Treasurer and the eight elected members of the Executive Committee; (b) one Fellow elected by each Division of the Association; and (c) the representatives of affiliated organizations, as provided for in Article VII, Section 2, of this Constitution. Each council member shall serve until his successor shall have taken office. The President shall be chairman of the Council; if the President shall be unable to serve as chairman at any session, the council members in attendance shall elect a chairman for that session. Twenty members of the Council shall constitute a quorum for the transaction of business.

Section 3. There shall be an Executive Committee of the Council, which shall execute such commitments as the Council may direct and shall make recommendations to the Council. Subject to this Constitution, to the bylaws, and to specific actions by the Council, the Executive Committee shall have power to act for the Council when the Council is not in session. At each annual meeting of the Association the Executive Committee shall render to the Council a report on actions taken by the Committee for the Council. The Executive Committee shall consist of thirteen members: the President Elect, the President, the Retiring President, the Administrative Secretary, the General Secretary, and eight Fellows elected by ballot of the Council, two each year for a term of four years. At any election of members of the Executive Committee, not more than one Fellow serving his fourth consecutive year as an elected member may be reelected. In the event of a vacancy in the office of an elected member of the Executive Committee, his successor for the remainder of the unexpired term shall be elected from among the Fellows by ballot of the Council at the next annual election. Six members of the Executive Committee shall constitute a quorum for the transaction of business. The Retiring President of the Association shall be chairman of the Executive Committee; if he shall be unable to serve at any session of the Committee, the committee members in attendance shall elect a chairman for that session.

Section 4. There shall be a Finance Committee, consisting of the Treasurer, the Administrative Secretary, and four members elected by the Executive Committee, one each year for a term of four years. The Finance Committee shall advise the Treasurer regarding purchases and sales of securities for the Association. Upon request of the Executive Committee, the Finance Committee shall make recommendations to the Executive Committee re-

garding financial questions. The Finance Committee shall report its actions annually to the Executive Committee. The Chairman of the Finance Committee shall be one of its elected members, appointed by the Executive Committee to serve throughout his term of membership in the Finance Committee. Any vacancy in the Finance Committee shall be filled by the Executive Committee. Four members of the Finance Committee shall constitute a quorum for the transaction of business.

Section 5. The term of office of each of the eight elected members of the Executive Committee and of each of the four appointed members of the Finance Committee shall begin on the January fifteenth following his election or appointment, and each shall serve until his successor shall have taken office.

Section 6. The Council may establish additional committees, each of which shall include at least two members of the Council and shall stand until discharged. Such additional committees shall report to the Council at each annual meeting unless otherwise directed at the time of their establishment.

ARTICLE V—SECTIONS

Section 1. The Association shall consist of fifteen Sections, designated as follows: Mathematics (A), Physics (B), Chemistry (C), Astronomy (D), Geology and Geography (E), Zoological Sciences (F), Botanical Sciences (G), Anthropology (H), Psychology (I), Social and Economic Sciences (K), History and Philosophy of Science (L), Engineering (M), Medical Sciences (N), Agriculture (O), and Education (Q). Additional sections or subsections may be established by vote of the Council. Each member of the Association may designate the section in which he wishes to be enrolled and may designate one additional section in which he is interested.

Section 2. The Vice President for a Section shall be *ex officio* chairman of that Section.

Section 3. The affairs of each Section shall be managed by a Section Committee consisting of (a) the Chairman and the Secretary of the Section; (b) other members of the Council who are primarily enrolled in the Section; and (c) four Fellows, one elected each year by the Section Committee for a term of four years. No person shall serve concurrently in more than one Section Committee. If an elected member of a Section Committee shall have resigned or died, his successor for the remainder of the unexpired term shall be elected from among the Fellows by the Executive Committee from nominations made by the Section Committee. One-third of the members of a Section Committee shall constitute a quorum for the transaction of business.

Section 4. The Section Committee of each Section shall promote the work of the Association in its own field and may organize subcommittees for that purpose. It shall arrange such section programs as it shall deem desirable for meetings of the Association, either separately or in cooperation with other sections of the Association or with independent societies. With the approval of the Executive Committee, a Section Committee may arrange section meetings to be held at places and times other than those of Association meetings.

ARTICLE VI—DIVISIONS AND BRANCHES

Section 1. Regional Divisions and Local Branches of the Association may be authorized by vote of the Council, for the purpose of promoting the work of the Association in their respective territories.

Section 2. Each Regional Division or Local Branch shall elect its officers for such terms as it shall prescribe and shall hold its meetings and conduct its affairs as it shall deem desirable, subject to the relevant provisions of this Constitution and of the Bylaws of the Association, and to such special provisions as the Council of the Association shall have established.

ARTICLE VII—AFFILIATED AND ASSOCIATED ORGANIZATIONS

Section 1. To facilitate cooperation between the Association and other organizations, and among the latter, the Council may elect an organization to be an officially affiliated or an officially associated academy or society.

Section 2. Each organization elected to be an Affiliated Society shall be entitled to name one Fellow of the Association to represent it in the Council; if it has more than one hundred members who are Fellows of the Association, it shall be entitled to name an additional Fellow of the Association to represent it in the Council.

ARTICLE VIII—MEETINGS

Section 1. The Association shall hold an annual meeting each year at such time and place as the Council shall have determined. Other meetings of the Association or of its sections may be authorized by the Council.

ARTICLE IX—PUBLICATIONS

Section 1. Summarized Proceedings of the Association and Directories of its Officers and Members shall be published at such times and in such manner as the Council shall have directed. By authorization of the Council, the Association may arrange for the production and distribution of journals, books, and other publications.

ARTICLE X—FUNDS

Section 1. Funds of the Association shall be classified as Current Funds, Investment Funds, and Trust Funds.

(a) *Current Funds* shall include all dues of annual members, all receipts from publications and all other funds received in the continuing operations of the Association.

(b) *Investment Funds* shall include all gifts and bequests received without special restriction concerning the use to be made of principal and income, and all other funds designated by the Council as investment funds. Investment Funds shall be invested in securities or other properties or held in cash while awaiting investment. Both principal and income of Investment Funds may be used for any purpose, but only after specific appropriations by the Council.

(c) *Trust Funds* shall consist of all life-membership contributions, all sustaining-membership contributions, all funds appropriated by the Council for establishing special life memberships, all gifts and bequests accepted with

specific restrictions prohibiting their allotment to either Current Funds or Investment Funds, and all other funds designated by the Council as Trust Funds. Trust funds shall be invested in securities or other income-producing properties, or held in cash while awaiting investment. The principal of every trust fund shall be maintained in perpetuity unless otherwise originally provided by the donor thereof or by the Council. Income from any trust fund shall be used only after special appropriation by the Council. Income from trust funds received as gifts or bequests may be appropriated only for purposes prescribed by the donors thereof, and income from other trust funds, except individual life-membership contributions while the contributors thereof are living, may be appropriated only for the support of research unless otherwise prescribed by the Council when the funds were established. It is provided that income from individual life-membership contributions may be appropriated by the Council for any purpose so long as the respective contributors are living.

Section 2. The Administrative Secretary shall be custodian of all Current Funds, which he shall collect and disburse under the direction of the Executive Committee. He shall collect life-membership and sustaining-membership contributions and shall transfer them to the Treasurer for allocation to Trust Funds. Every check issued by the office of the Administrative Secretary shall bear two signatures, those of the Administrative Secretary and the Assistant Administrative Secretary or those of the Treasurer and either the Administrative Secretary or the Assistant Administrative Secretary. The Administrative Secretary, the Assistant Administrative Secretary and the Treasurer shall be bonded in favor of the Association for such amounts as the Executive Committee shall have determined.

Section 3. The Treasurer shall be custodian of all Investment Funds, all Trust Funds, and all other funds placed in his charge by action of the Council. He shall administer gifts and bequests in accordance with such provisions as shall have been made by the donors thereof. Unless otherwise directed by the Council, he shall sell securities from the investment portfolio of the Association, and purchase securities for the investment portfolio, in accordance with such advice of the Finance Committee as shall have been formally recorded in the minutes of its meetings. He shall collect the income of all funds in his charge and shall dispose of it as directed by the Council. Every check issued by the office of the Treasurer shall bear two signatures, that of either the Treasurer or the Chairman of the Finance Committee and that of either the Administrative Secretary or the Assistant Administrative Secretary.

ARTICLE XI—RATIFICATION AND AMENDMENTS

Section 1. This Constitution shall become effective one month after it shall have been ratified in accordance with the procedure established for amending the Constitution of 1919. It shall invalidate the Constitution of 1919 and all amendments thereto.

Section 2. To become effective, any proposed amendment to this Constitution of 1944 shall be approved by the Executive Committee, published in the official journal of the Association at least one month prior to an annual meeting of the Association, and ratified either (a) by a nine-tenths vote of the Council members present in a Council session of that meeting or (b) by a two-thirds vote of the Council members present in each of two Council sessions held at consecutive annual meetings of the Association. Ratified amendments shall be published promptly in the official journal of the Association and shall become effective one month after ratification.

OBITUARY

PHILIP FOX

A COLORFUL career came to a close in the death of Philip Fox on July 21, 1944. He had been an observational astronomer, a popularizer of astronomy and other sciences, and an army officer in three wars.

Born in Manhattan, Kansas, on March 7, 1878, he grew up in that state and was graduated from Kansas State College in 1897. He continued for a year as graduate assistant in engineering and afterwards was commandant and teacher of mathematics in St. John's Military School in Kansas. In 1901, although he held both B.S. and M.S. degrees from Kansas State, he entered Dartmouth College as a senior to get the experience of undergraduate life in New England. Here he came under the tutelage of Edwin B. Frost and became interested in astronomy as a life work. At Dartmouth also at this time was his distinguished cousin, Ernest Fox Nichols, professor of physics, under whom Fox studied and also served for a year as graduate assistant after receiving the bachelor's degree from Dartmouth in 1902.

In 1903 Fox began his astronomical career at the Yerkes Observatory, where he was to remain for the next six years, with a year out for study at the University of Berlin and the Potsdam Observatory. At Yerkes his main duties were with the Rumford spectroheliograph which had been developed by Hale. Besides routine observations Fox published a series of papers on prominences and other solar phenomena; later his comprehensive monograph on the rotation of the sun appeared as a publication of the Yerkes Observatory.

In 1909 Fox was called to be director of the Dearborn Observatory and professor of astronomy in Northwestern University, a post he held for twenty years. Many of the present generation of astronomers are unaware of the great influence exerted by S. W. Burnham on American astronomy. Working for the

most part as an amateur, Burnham initiated the practice of using a telescope during all of a good clear night. Previous to his time this procedure had been little followed anywhere in the world. The 18½-inch refractor at the Dearborn Observatory had had an illustrious history in double star astronomy, beginning with the discovery of the companion of Sirius in the tests of the objective by the maker, Alvin Clark. Then followed a number of discoveries by Burnham and a long list of investigations by G. W. Hough, director for thirty years until his death in 1909. It was therefore natural that Fox should start a program of double-star observations, influenced and inspired as he was by association with Burnham at Yerkes. After securing a new mounting for the telescope he measured double stars with unusual vigor and persistence for the next fifteen years, and the results are brought together in the first two volumes of the *Annals of the Dearborn Observatory*.

Concurrently with the double-star work Fox initiated the determination of stellar parallaxes by photography, following Schlesinger, who had achieved such revolutionary success by this method with the 40-inch Yerkes refractor. This program was carried on for nearly twenty years, the results appearing in Volume 3 of the Dearborn *Annals*, where on the title page are recorded the names of no fewer than twenty-four assistants and students who had been trained and had taken part in the work. Parallaxes were determined for nearly two hundred stars, a labor which only those experienced in this field can appreciate.

The major scientific investigations of Fox are thus recorded permanently in the three volumes mentioned, and the respective dedications of these volumes give an insight to his own appreciation of his debt to his astronomical forbears. The first volume was naturally dedicated to S. W. Burnham, the second to Edwin B. Frost, Fox's first teacher of astronomy, and the third to Henry Crew, colleague and friend, who had nominated him for the directorship of the Dearborn Observatory.

With the organization of the Adler Planetarium in Chicago in 1929 Fox entered a new field of activity. Selected as the director of the first planetarium in America he did much to establish and maintain the high standard which has come to be associated with these institutions for the dissemination and popularization of astronomy. Fox will be remembered by many radio listeners as the master of ceremonies on the occasion of the opening of the Chicago World's Fair in 1933 by the light of Arcturus which had left the star near the time of the previous World's Fair of 1893. Fox was active director of the planetarium for eight years and continued for some time later as consultant.

In 1937 he was appointed director of the Museum of Science and Industry of Chicago, and was active in the new developments of that institution. However, in 1940 owing to a change of policy of the governing board, Fox was suddenly ousted together with several department heads, some of long service. Whatever the reasons, it will be a long time, if ever, before the Museum of Science and Industry recovers from that black mark on American science.

With war coming on Fox was not long without something to do. He had been interested in military things since early youth. In 1898 he had gone to the Philippines as second lieutenant in a Kansas regiment and had remained there till the close of hostilities. Between wars he continued in the Officers Reserve Corps, and from 1917 to 1919 he was again active as major of infantry and assistant chief of staff of the Seventh Division in France. In peace time he maintained relations with the officers at nearby Fort Sheridan, Illinois. It was natural, therefore, that soon after the involvement of the United States in the present war he was recalled to active service as a full colonel in the army. His first duty was the supervision of athletics in the various camps, but he afterwards came to the appropriate post of commanding officer of the Army Electronics Training Center at Harvard. After some three years on this congenial task he was retired from the army on account of age, but he continued to lecture on electronics and to teach in the officers' training course at Harvard.

No brief account of Fox's career can cover his various activities. Besides teaching, research, athletics and military service, he was much interested in music and art. Within the last year amidst strenuous regular duties he was playing the violin in a small musical ensemble; he set some French poems to music; and made etchings of buildings at Harvard.

Fox was of course a member of many societies, national and international. He served as secretary and then vice-president of section D of the American Association for the Advancement of Science, and held the same offices in the American Astronomical Society. He was naturally the leading spirit in the Chicago Astronomical Society. He received honorary doctor's degrees from Drake University and from his alma mater, Kansas State College.

He maintained his unusual vigor of mind and body up to about a month before the end, when he was suddenly stricken with a cerebral hemorrhage and then a thrombosis caused his passing at the age of sixty-six. Though he did not reach the allotted span of three score and ten, measured in years of work and service, his was a long and useful life, and to very few is given the privilege of such a widespread circle of friends.

Fox was married in 1905 to Ethel L. Snow, of Chicago, who survives. Their four children are Bertrand, of Washington, D. C., Stephen S., of Bethlehem, Pa., Captain Robert T. Fox, Army Medical Corps, and Dr. Gertrude Fox, of Glendale, Calif.

JOEL STEBBINS

WASHBURN OBSERVATORY,
UNIVERSITY OF WISCONSIN

RECENT DEATHS

MORTIMER E. COOLEY, from 1904 to 1928, when he became emeritus, dean of the College of Engineering of the University of Michigan, died on August 25 at the age of eighty-nine years.

DR. JOHN MEAD ADAMS, associate professor of physics at the University of California at Los Angeles, died on August 14 at the age of sixty-two years. The death was by suicide, the result of a period of ill health and despondency.

FREDERIC J. LE MAISTRE, consulting chemical engineer of Philadelphia, from 1930 to 1937 executive secretary of the American Institute of Chemical Engineers, died on August 25 at the age of sixty-five years.

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH FELLOWSHIPS IN GREAT BRITAIN

THE directors of Imperial Chemical Industries announce that they have offered for an initial period of seven years to provide at nine universities in Great Britain fellowships to be held by senior workers in certain sciences. The fellowships will be of the average value of £600 per annum, though the universities will have power to determine the emolument for each particular appointment.

The directors have described on broad lines the subjects in which the fellowships are to be held. Their administration rests wholly with the universities, which will select and appoint the fellows, subject only to such conditions as to duties and tenure as the universities themselves impose. According to *The Times*, London, the purpose of the directors is to strengthen the general provision in the British universities for scientific teaching and research. They believe that academic and industrial research are interdependent and complementary and that substantial advances in industry can not be looked for without corresponding advances in academic science.

In their view it is important that the immediate objective should be the strengthening of university scientific departments in whatever way each university thinks to be best. No conditions whatever are attached by the directors to the tenure of these fellowships. The fellows will be members of the university staffs and will be concerned only with the duties laid upon them by the universities. Their primary work will lie in research. But they must also take some part in university teaching. It is intended not to relieve the universities from the cost of maintaining any part of their normal work but to enable them to add to what they already do.

This offer has been made to the larger metropolitan universities and to those which have a close geographical relation to the main centers of the company's production. Twelve fellowships have been offered to the universities of Oxford, Cambridge and London; eight to the universities of Glasgow, Edinburgh, Manchester, Birmingham and Liverpool, and four to the University of Durham.

The directors believe that a rational policy of this character, together with a wise selection of men as regards both capabilities and tenure of office, will lead to the emergence of a body of men capable of taking high academic or industrial positions, thereby advancing academic and industrial research.

Lord McGowan, chairman of Imperial Chemical Industries, in a letter to the chancellors of the universities concerned, states that in launching the scheme the directors hoped that the fellowships would lead to a reasonable cooperation among the beneficiaries, which would among other things do something to overcome the disadvantages of a man spending his whole career at one university. "We hope that fellows will be elected in such a manner as will strengthen a school of an essential subject which is temporarily weak, adequately assist one already strong, and not attempt to do something which is manifestly much better done elsewhere. It is reasonable to assume that if our scheme works well others may feel disposed to make similar subventions."

It is understood that the subjects laid down are physics, chemistry and the sciences dependent thereon, including chemotherapy—that is to say, any branch of physics or chemistry may be included as well as applied sciences, such as metallurgy and engineering. The importance of these sciences may be appreciated by the fact that they constitute the background of modern industry.

THE REGISTRY OF VETERINARY PATHOLOGY AT THE ARMY INSTITUTE OF PATHOLOGY

RECENTLY an arrangement was approved by the Surgeon General of the U. S. Army and the Board of Governors of the American Veterinary Medical Association for the establishment and maintenance at the Army Institute of Pathology, Army Medical Museum, Washington, D. C., of a Registry of Veterinary Pathology. This registry will become a unit of the American Registry of Pathology, an organization operating by the authority of the Surgeon General under the sponsorship of the National Research Council.

The purpose of the American Registry of Pathology

is comprehensive investigation in certain special fields, which at present comprise ophthalmic pathology, otolaryngitic pathology, orthopedic pathology, dental and oral pathology, neuropathology, dermatologic pathology, pathology of neoplasms, with special consideration to those of the endocrine glands, the kidney, the urinary bladder and the lungs. Through close cooperation with various national societies, records and material in these several specialties are brought together at the Army Institute of Pathology for systematic study. The number of specimens received is considerable; for example, there are now available for investigation 4,747 tumors of the urinary bladder and nearly 2,000 malignant melanomas of human eyes. There are also on hand prepared sections of eyes from many different species of animals. All the material and the records of the registry are available for study to graduate students, specialists, as well as to other authorized persons.

For the Registry of Veterinary Pathology it is desired to assemble (a) material representing general pathologic anatomy, including vitamin deficiencies, specific diseases of different tissues and organs, and examples of natural and experimentally induced neoplasia; (b) a complete collection of prepared slides representing the normal histology of the different species of animals, including domesticated and wild mammals, birds and cold-blooded vertebrates, and (c) material illustrating experimentally induced lesions of infectious diseases.

As material accumulates, loan sets of slides will be made available for study. Similarly, sets of lantern slides will be prepared which pertain to topics of special importance; these also will be available for loan to contributors.

This announcement is for the information of veterinarians and others interested in comparative pathology; it is hoped that they will make full use of the registry and send to it material deemed of interest for teaching and for the investigation of animal and human diseases. Material submitted should be addressed to The Director, Army Institute of Pathology, Army Medical Museum (attention: Registry of Veterinary Pathology), 7th and Independence Avenue, S.W., Washington 25, D. C. The director will be glad to furnish further instructions to contributors for submission of material.

Members of the Special Committee on Registry of Veterinary Pathology are Dr. W. H. Feldman, Mayo Foundation, *Chairman;* Captain Charles L. Davis, V.C., Army Institute of Pathology; Dr. Harry W. Schoening, chief of the Pathological Division, U. S. Bureau of Animal Industry; *Member Ex-officio,* Lieutenant Colonel Balduin Lucké, M.C., deputy director of the Army Institute of Pathology.

THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

THE Mount Desert Island Biological Laboratory held the annual meeting of the Corporation and Board of Trustees on the Laboratory grounds in Salisbury Cove, Maine, on August 10. Dr. Ulric Dahlgren, of Princeton University, was re-elected *president* of the corporation, and Dr. Roy P. Forster, of Dartmouth College, was elected director of the laboratory. Other officers elected were Dr. Dwight E. Minnich, of the University of Minnesota, *vice-president;* John Whitcomb, Bar Harbor, Maine, *treasurer and clerk;* and Dr. J. Wendell Burger, Trinity College, *secretary.*

The following were elected members of the Board of Trustees:

Dr. Warren H. Lewis, Carnegie Institution of Washington; Dr. William H. Cole, Rutgers University; Dr. E. K. Marshall, Jr., the Johns Hopkins University; David O. Rodick, Bar Harbor, Maine; Dr. Stanley J. G. Nowak, Boston City Hospital; Dr. Edwin P. Hiatt, New York University; Dr. Clarence C. Little, Jackson Memorial Laboratory; Dr. Dwight E. Minnich, University of Minnesota; Dr. Homer W. Smith, New York University; Dr. J. T. Halsey, Tulane University; Dr. Esther F. Byrnes, Philadelphia; Dr. Earl O. Butcher, New York University; Dr. Ulric Dahlgren, Princeton University; Dr. J. Wendell Burger, Trinity College; John Whitcomb, Bar Harbor, Maine; Dr. R. P. Forster, Dartmouth College, and A. S. Johnson, Rutgers University.

Plans were laid to offer the full facilities of the laboratory for research use during the summer season of 1945 (June to October). Biologists interested in problems involving the Acadian fauna and flora of the Gulf of Maine region may address inquiries to Dr. R. P. Forster, Dartmouth College, Hanover, N. H.

LATIN-AMERICAN GUGGENHEIM FELLOWSHIPS

AWARDS of Guggenheim fellowships for research and creative work by Latin-American scholars and artists have been announced.

Five of these were awarded to investigators in Mexico, four in Argentina, three in Chile and one each in Cuba and Brazil. In the sciences, two were awarded in mathematical physics, three in biology and one in chemistry as follows:

ALBERTO BARAJAS CELIS, professor of algebra, faculty of sciences, and investigator, Institute of Mathematics, National University of Mexico, Mexico City. *Project:* Studies of the theory of gravitation, principally with Dr. George D. Birkhoff, professor of mathematics, Harvard University.

GUIDO MUNCH PANIAGUA, calculator in the National Observatory of Mexico, Tacubaya. *Project:* Studies in the field of theoretical astrophysics at the Yerkes Observa-

tory of the University of Chicago at Williams Bay, Wis., under the direction of Dr. Otto Struve.

DR. EDUARDO CABALLERO y CABALLERO, chief of the laboratory of helminthology, Institute of Biology, National University of Mexico, Mexico City. *Project:* Research in helminthology, in particular, studies of the problem of onchocerciasis.

PROFESSOR MANUEL MALDONADO KOERDELL, chairman of the section of natural history, Institute of Scientific Research, University of Nuevo Leon, Monterrey, N. L., Mexico. *Project:* Studies in comparative anatomy, especially of the vertebrate skeleton. He will work principally with Dr. E. Raymond Hall at the University of Kansas.

DR. ELISA HIRSCHHORN, plant pathologist, La Plata, Argentina. *Project:* Studies of the biology of the smut fungi. She will work at the University of Minnesota and at Harvard University.

DR. RAFAEL AURELIANO LABRIOLA, chief of the laboratory of organic chemistry, faculty of science, University of Buenos Aires, Argentina. *Project:* Studies of methods of quantitative microanalysis and of the techniques of hydrogenation at normal and high pressures. Dr. Labriola plans to work at the University of Minnesota and the University of Wisconsin.

Members of the committee of award include Dr. Frank Aydelotte, director of the Institute for Advanced Study, Princeton, *Chairman;* Dr. Thomas Barbour, director of the Museum of Comparative Zoology, Harvard University; Dr. Percival Bailey, professor of neurology and neurosurgery, Medical School of the University of Illinois; Dr. Américo Castro, professor of Spanish, Princeton University, and Dr. Elmer Drew Merrill, professor of botany and director of the botanical collections of Harvard University.

The fellowships, which provide the sum of $2,000 and traveling expenses to and from the United States, were established in 1929 by the late Senator Simon Guggenheim and Mrs. Guggenheim under the auspices of the Guggenheim Foundation, which they had founded in 1925.

SCIENTIFIC NOTES AND NEWS

THE Cedergren Gold Medal of the Royal Technical University, Stockholm, awarded once every five years, has been conferred on Ernst F. W. Alexanderson, consulting engineer and radio expert of the General Electric Company, "in recognition of his prominence as an author of electrotechnics." The medal will be delivered to him by the Swedish legation.

HONORARY ACADEMICIAN NIKOLAI MOROZOV, known for his investigations in astronomy and geophysics, has been awarded the Order of Lenin for distinguished work in the natural sciences.

CAPTAIN BENNET F. BUIE, attached to the Persian Gulf Service Command of the Corp of Engineers of the U. S. Army, has been awarded the Order of the Red Star by the U.S.S.R. "for outstanding ability and professional skill in locating and developing a dependable water supply for the Russian Military Service."

THE Gilbert Blane Medal of the Royal College of Surgeons has been awarded to Surgeon Commander W. A. Hopkins of the Royal Navy.

DR. ROBERT H. RICHARDS, professor of mining engineering, emeritus, of the Massachusetts Institute of Technology, which he joined as assistant in chemistry in 1868, celebrated his hundredth birthday on August 26.

THE University of Cincinnati at its one hundred and twenty-fifth commencement conferred the doctorate of laws on Major General Paul R. Hawley, chief medical officer of the Army in the European Theater of Operations, a graduate in 1914 of the College of Medicine, in recognition of "his distinction as physician, scholar, administrator and soldier, twice decorated for conspicuous military achievement."

THE University of Birmingham at its annual convocation conferred the honorary degree of D.Sc. on Ernest Ansley Watson in recognition of "his distinguished contributions to electrical engineering and, in particular, of his work on magnetos and on the electric lighting of mines."

IT is reported in *Nature* that W. P. Wynne, F.R.S., emeritus professor of chemistry in the University of Sheffield, has been elected a fellow of the Imperial College of Science and Technology, which he entered as a student sixty-three years ago.

RICHARD MORRIS, since 1909 professor of mathematics at Rutgers University, has retired with the title professor emeritus. He has been a member of the faculty for forty-five years, since 1915 as head of the department.

DR. JAMES L. WILSON, professor of pediatrics at the New York University College of Medicine, has been appointed professor and chairman of the department of pediatrics and communicable diseases of the Medical School of the University of Michigan.

DR. FRANCIS D. GUNN, associate professor of pathology at the Medical School, in Chicago, of Northwestern University, has been appointed professor and head of the department of pathology of the School of Medicine of the University of Utah.

DR. WILL S. THOMPSON has resigned from the Chemicals Bureau of the War Production Board to

become head of the department of physical sciences at Kent State University, Ohio.

DR. HOWARD M. MARGERISON, formerly dean of the College of Dentistry of the University of Illinois, has become associate director of the Forsyth Dental Infirmary, Boston. Dr. Philip E. Blackerby has been appointed dean of the School of Dentistry of the University of Louisville, succeeding Dr. John T. O'Rourke, who will join the staff of the School of Dentistry of Tufts College.

DONALD J. LE ROY, of the National Research Laboratories at Ottawa, has been appointed assistant professor in the department of chemistry of the University of Toronto.

DR. DOUGLAS WHITAKER, professor of zoology at Stanford University, has been elected a member of the editorial board of *The Biological Bulletin*.

DR. EARL C. MCCRACKEN, associate professor of physics at Teachers College, Columbia University, has resigned to become physicist for the Bureau of Human Nutrition and Home Economics at the laboratories at Beltsville, Md., of the U. S. Department of Agriculture.

DR. ORLAN MCGREW ARNOLD, assistant professor of chemistry at the Rensselaer Polytechnic Institute at Troy, N. Y., has been placed in charge of the laboratory for physical chemistry in Detroit of the Chrysler Corporation.

DR. JACOB SACKS, assistant professor of pharmacology at the Medical School of the University of Michigan, has been appointed director of the pharmacologic laboratory of Endo Products, Inc.

DR. GEORGE C. SUPPLEE, associate director of the research division of the Borden Company, has become head of the newly established G. C. Supplee Research Corporation, Bainbridge, N. Y.

DR. ARTHUR W. GALSTON, formerly plant physiologist with the guayule rubber project at the California Institute of Technology, is now in training at the Great Lakes Naval Training Station, preparatory to a career as a radio technician in the Navy.

DR. ROBERT REDFIELD, professor of anthropology and dean of the Division of Social Sciences of the University of Chicago, has been granted nine months' leave of absence in order to visit China. He is expected to leave this country in the late summer. Under the joint auspices of the Social Science Research Council and the University of Chicago, he will visit educational institutions in Free China to confer with Chinese scholars in the social sciences, who have been cut off from the outer world by the war. He expects to visit the principal institutions, both governmental and private, which are engaged in social science research in Kunming, Chungking, Chengtu, Kweiyang and other Chinese cities. Dr. Redfield during this trip would be glad to be of assistance to any American scholar who has interests in China.

DR. GEORGE M. CURTIS gave on June 21 the Leroy Long Memorial Lecture at Oklahoma City, on "The Surgery of the Spleen." Dr. Long was formerly dean and professor of surgery at the Medical School of the University of Oklahoma.

THE Graduate Fortnight of the New York Academy of Medicine will be held from October 9 to 20. The program includes panel discussions, hospital clinics, addresses and scientific exhibits and demonstrations. The Ludwig Kast Lecture will be delivered by Dr. René J. Dubos, of the Rockefeller Institute for Medical Research. He will speak on "The Mode of Action of Antibacterial Agents," and the Carpenter Lecture will be given by Dr. Thomas Francis, Jr., of the School of Public Health of the University of Michigan. His subject will be "Influenza—Methods of Study and Control."

THE Executive Committee of the Genetics Society of America has voted to cancel the Cleveland meetings of the society in response to the urgent appeal of the Office of Defense Transportation. The current issue of the *Records* of the society is being mailed to members and will contain abstracts of the papers that were to have been presented at the meetings.

A COURSE of twelve Tuesday evening lectures on "New Tools in Chemical Research," given by specialists, will be offered by University College of Northwestern University from September 26 to December 12. Special attention will be given to ultraviolet and infrared spectroscopy, polarography and magnetochemistry. The course will include demonstrations, exhibitions and lantern slides. In addition, instruction will be given in beginning technical Russian, designed to assist specialists in the translation of Russian scientific literature.

THE Lewis Cass Ledyard, Jr. Fellowship, the income of which amounts to approximately $4,000 annually, will be awarded to an investigator in the fields of medicine and surgery, or in any closely related field. This sum will be applied as follows: $3,000 as a stipend and, approximately, $1,000 for supplies or for the expenses of the research. Preference will be given to younger applicants who are graduates in medicine, and who have demonstrated fitness to carry on original research of high order. Research work under this fellowship is to be carried out at the New York Hospital and Cornell University Medical College. The fellowship will be available on July 1 at the beginning of the academic year. Appli-

cations for the year 1945–46 should be in the hands of the committee by December 15. It is expected that the award will be made by March 15, 1945. Application for the fellowship should be addressed to The Committee of the Lewis Cass Ledyard, Jr. Fellowship, The Society of The New York Hospital, 525 East 68th Street, New York, N. Y.

ACCORDING to an Associated Press dispatch from San Francisco, the Federal Circuit Court of Appeals on August 23 withdrew its opinion of June 30, 1943, which invalidated valuable patents held by the Wisconsin Alumni Research Foundation for preventing and curing rickets through food treated with ultraviolet rays. The court gave no explanation of its action. The university had petitioned for a rehearing, and action still is pending. The opinion given down a year ago was to the effect that a process using sunlight could not be patented, since solar energy was available to all mankind, and that the Steenbock patents were invaluable discoveries but not inventions. The patents have yielded $7,500,000 in royalties from 250 licensed companies.

THE Royal Institution of Great Britain has established nine graduate memberships, three of which will be awarded annually to recent graduates, of either sex, of any university in the British Empire who have taken a degree with either first or second class honors in any scientific subject. Membership will give the holder the full privileges of members for three years, except the right to attend or to vote at any meeting.

BY authorization of the University Court the department of chemistry in relation to medicine of the University of Edinburgh will in future be known as the department of biochemistry.

IT is reported in *The Times*, London, that it has been decided to take back to London, for the session beginning on October 1, the Faculties of Arts, Science and Engineering, which for five years have been evacuated. In spite of the badly damaged state of the University College buildings, it is hoped that the Science and Engineering Departments will be able to reopen with normal laboratory equipment for teaching. The Faculty of Arts, almost the whole of the accommodation for which has been destroyed by enemy action, will be housed in temporary quarters now being prepared.

THE first report of the British Colonial Products Research Council has been issued as a White Paper, according to which preliminary results of laboratory experiments have shown the possibility of turning large quantities of secondary timbers, for which there is no economic use at present, into a carbohydrate suitable for use as cattle food. By the methods so far developed in producing the cattle food from timber, the price appears to be too high to permit of its use in the Colonies, but the position might be altered by finding some use for the effluent liquors. Further research will be carried out, as well as a general survey of various Colonial secondary timbers, to discover their suitability for chemical treatment. This, the report says, will be a long-term and highly speculative research, but a successful outcome would exert a profound effect on the economic use of Colonial forests.

DISCUSSION

NOMENCLATURE OF THE HUMAN MALARIA PARASITES

THE names for the malarial parasites of man have long been the subject of discussion, much of which has hopelessly intermixed zoological and nomenclatorial considerations. Stiles (1928, Opinion 101, p. 13) has aptly remarked that "the nomenclature of the parasites of malaria in man and birds represents one of the most confusing chapters in the entire history of zoological nomenclature."

The problem has been very ably and painstakingly reviewed by Christophers and Sinton.[1] We have carefully studied their paper, we concur in their conclusions, and we agree that strict adherence to the International Rules of Zoological Nomenclature would result in great confusion. The nomenclature adopted in Opinion 104 is clearly the best solution to the problem and should be maintained. However, we feel it necessary to point out that Opinion 104 did not provide an official answer, notwithstanding the fact that zoologists have for years regarded it as the final decision in the matter.

[1] R. Christophers and J. A. Sinton, *British Medical Journal*, 2: 1130–1134, 1938.

NOMENCLATURE OF THE HUMAN MALARIA PARASITES UNDER A STRICT INTERPRETATION OF THE RULES

Oscillaria Laveran, 1881, (type, *O. malariae* Laveran, 1881, the parasite of malignant tertian malaria; by monotypy). Malariologists are now agreed that Laveran had the sexual forms of this species, only, in his first paper cited above.

= *Plasmodium* Marchiafava & Celli, 1885, (type, *P. malariae* Laveran, 1881, parasite of malignant tertian malaria; by monotypy).

= *Haemamoeba* Feletti & Grassi, 1890, (type, *H. malariae* Feletti & Grassi, 1890, parasite of tertian and quartan fevers in man; by monotypy). The name

has been shown to include two species, and therefore is not really monotypic. Grassi & Feletti later in 1890 restricted *malariae* Feletti and Grassi to the parasite of quartan fever and proposed *H. vivax* for the tertian producing form. Result: the type of *Haemamoeba* is *H. malariae* Feletti and Grassi, as restricted by Grassi and Feletti to quartan fever. In the genus *Plasmodium* it is a secondary homonym of *malariae* Laveran, 1881, and the next oldest available name, *quartanae* Celli & Sanfelice, 1891, is valid.

= *Laverania* Feletti and Grassi, 1889, (cf. footnote, Christophers and Sinton, 1938, p. 1133) (type, *Oscillaria malariae* Laveran; by monotypy).

= *Haematozoon* Welch, 1897, (type, *Haematozoon falciparum* Welch, 1897; by monotypy).

Conclusions, under a strict interpretation of the Rules:

(1) If zoologists agree on one genus for the malarial parasites, its name, as shown above, would be *Oscillaria* Laveran, because this name is not invalidated either by previous use in botany (Code, Article 1) or by its unsuitability (Article 32). It will be noted that all five generic names were monotypic as originally proposed, and that three—*Oscillaria, Plasmodium, Laverania*—have identical type species and would be isogenotypic synonyms whatever classification is used.

(2) If zoologists decide that two genera are required, the name *Oscillaria* would be strictly correct for the parasite of malignant tertian fever, and *Haemamoeba* for the other two.

(3) The names of the classical species of malaria under a single genus would be as follows:

Oscillaria vivax (Grassi & Feletti, 1890)—Tertian malaria.

Oscillaria quartanae (Celli and Sanfelice, 1891)—Quartan malaria (to replace *malariae* Feletti & Grassi, 1890 nec Laveran 1881).

Oscillaria malariae Laveran, 1881—Malignant tertian malaria.

It is generally agreed that such conclusions would result in great confusion in medical and zoological literature. The generic name *Plasmodium* and the specific names *malariae* (quartan)[2] and *falciparum* (malignant tertian) have long been accepted by malariologists throughout the world. This usage was supported by Opinion 104 in which *Laverania* and *Plasmodium,* together with 55 other generic names, were placed on the "Official List of Generic Names" with "malariae (as restricted to quartan fever)" designated as the type of *Plasmodium* and *falciparum* Welch (1897) designated as type of *Laverania.* The matter would thus appear to have been settled but for the following significant statement by Stiles (1928) in the presentation of the case for Opinion 104: "The Secretary has personally checked these names and believes that they are all nomenclatorially available and valid, and that, therefore, they can be adopted in harmony with the Rules instead of as Nomina Conservanda."

Contrary to this usage in Opinion 104, it is clear that *malariae* as used in the combination *Laverania malariae* by Grassi and Feletti was *not* a homonym but was the original *malariae* of Laveran, that *falciparum* therefore was an unnecessary substitution, that *falciparum* after all was not the next oldest available name, that "*malariae* (as restricted to quartan fever)" could not be the valid type of *Plasmodium* Marchiafava and Celli, 1885, since the *Plasmodium* of that date was based on *malariae* Laveran, the parasite of malignant tertian fever, and that *Oscillaria* Laveran, 1881, antedates both of the above generic names.

To have arrived at any one of the conclusions stated in the Opinion would therefore have required a Suspension of the Rules. Inasmuch as the Rules were not suspended for any of the names approved in Opinion 104, we submit that the names *Laverania* and *Plasmodium* hold a place on the Official List in direct contravention of the Rules, rather than being maintained and protected by them.

In the present instance, we are faced with an "Official List" containing certain names which are not official in the sense that the action necessary to make them so was never taken. We can find no justification for believing that names placed on the Official List, merely in the absence of any expressed "objection, question, or adverse comment" (Opinion 75, p. 35) at the time, are thereby conserved to eternity and not subject to critical evaluation. Since the names *Plasmodium malariae* (quartan) and *falciparum* (malignant tertian) are generally accepted in zoological and medical literature and since it was apparently the intention of the International Commission to fix these names, we respectfully request that the International Commission of Zoological Nomenclature legalize Opinion 104 as it applies to the malaria parasites by suspending the Rules and taking the following action:

1. Suppress the generic name *Oscillaria* Laveran (1881) in favor of *Plasmodium* Marchiafava and Celli, (1885).
2. Suppress the species name *malariae* Laveran (1881), and any other names for the parasite of malignant tertian malaria, in favor of *falciparum* Welch, (1897).
3. Establish *malariae* Feletti and Grassi (1889, 1890) nec *malariae* Laveran (1881) as the valid name for the parasite of quartan malaria.
4. Designate as the type of *Plasmodium* Marchiafava & Celli (1885)—*Haemamoeba malariae* Feletti & Grassi (1889, 1890).

[2] According to Christophers and Sinton (1938), the name *malariae* Laveran was first applied to quartan malaria erroneously by Lühe (1900).

5. Designate as the type of *Laverania* Feletti and Grassi (1889)—*Haematozoon falciparum* Welch (1897).

In summary, the actions recommended above would legalize existing practice as follows:

Plasmodium vivax (Grassi and Feletti, 1890), parasite of tertian malaria.

Plasmodium malariae (Feletti and Grassi, 1889, 1890), parasite of quartan malaria.

Plasmodium falciparum Welch (1897), parasite of malignant tertian malaria.

CURTIS W. SABROSKY
ROBERT L. USINGER

U. S. PUBLIC HEALTH SERVICE,
OFFICE OF MALARIA CONTROL IN WAR AREAS,
ATLANTA, GA.

A NEW PHILOSOPHY OF PREVENTIVE MEDICINE

To the significant accomplishments reported in a recent article concerning "Recent Contributions of the Preventive Medicine Service of the U. S. Army," which appeared in the issue of SCIENCE for July 21, 1944, there may be added accomplishments of a different nature which have resulted from the unique problems which occur in the Army Air Forces. I refer to the service which the Medical Department of the Army Air Forces has rendered to flying personnel.

The medical officer in the Army Air Forces has enjoyed always an intimate association with line personnel. From this association there has evolved a unique type of preventive medicine. It results from the interest of medical officers in equipment—equipment designed to protect flying personnel, thereby increasing their efficiency to that of their aircraft. Because the medical officer is concerned with the human organism, he scrutinizes equipment from the standpoint of its usability. In addition, he is in a position to supply the engineer with certain physiological data and criteria to be used as a basis for the construction of equipment.

That this point of view has actually been placed in practice is evidenced by the fact that the Air Surgeon has not only interested himself in oxygen equipment but also has been made responsible for its development. Without this equipment, personnel could not fly efficiently above ten thousand feet. It is obvious, therefore, that through the use of oxygen equipment the air man may operate efficiently at the altitudes to which his airplane is capable of flying. At the same time, he is protected from the adverse effects of anoxia.

A few of the other developments in which the Air Surgeon has interested himself, or for which he has been responsible, aimed at the maintenance of a normal physiology, the production of maximal efficiency or the prevention of injury in flying personnel are:

(1) *Shoulder harness:* This equipment is utilized to prevent injury on rapid deceleration, such as in a crash.

(2) *Parachutes and improved parachuting techniques:* At the instigation of the Air Surgeon, an extensive program in parachuting has been adopted by the Army Air Forces.

(3) *Anti-G equipment:* The Air Surgeon has been responsible for the development of equipment in the Army Air Forces for combating accelerative forces encountered in flight.

(4) *Gun turrets:* Anthropometric measurements and their applications have resulted in redesign of gun turrets and the arrangement of equipment in the turrets.

(5) *Aircraft instruments:* In order to promote the efficiency of pilots, the Air Surgeon has interested himself in standardization of aircraft instruments and cockpit arrangements, not only to prevent injuries, but also to increase the speed of learning and operation.

(6) *Flying clothing:* Investigations in the use of clothing, including electrically heated clothing, and other measures to combat cold and frostbite have been accomplished.

(7) *Flak suits:* The flak suit was originated by a senior flight surgeon, Brigadier General Malcolm C. Grow, U.S.A., as a measure to prevent injury to flying personnel from flak. It has proved to be successful and has prevented not only many serious injuries but also many deaths.

(8) *Ditching procedures:* Original impetus to the study of ditching procedures came from medical officers in the Army Air Forces in theaters of operation and has resulted in the prevention of injury to many individuals.

One of the most outstanding achievements in modern physiology has been the Altitude Training Program which was originated and is conducted by the Air Surgeon. This program has provided instruction in the physiology of flight to all flying personnel, in an attempt to prevent deleterious effects from flight through knowledge of the physiological problems encountered.

The opportunities for extension of this philosophy of preventive medicine to other fields in the postwar world are manifold.

HERMAN S. WIGODSKY,
Major, Medical Corps

AIR SURGEON'S OFFICE,
HEADQUARTERS ARMY AIR FORCES,
WASHINGTON, D. C.

SEX DIFFERENCES IN THE SCIENCE TALENT TEST[1]

IN each of the three years of the Science Talent

[1] The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

Search—conducted jointly by Science Clubs of America, Science Service, and the Westinghouse Electric and Manufacturing Company—differences between the scores of the boy entrants and the girl entrants on the Science Aptitude Examination have been noted.[2] The first year, for example, 22 of the 2,460 boys with complete entry materials made fewer than 5 errors, whereas this was not true of any of the 715 girls.

Yet the Science Aptitude Examination has been given under uniform conditions to boys and girls. It is open to all high-school seniors in the continental United States, and is equally publicized among them, since announcements and contest rules have been sent each year to every high school and secondary school in the country, public, parochial and private. The examination is essentially a self-administering paper-and-pencil academic aptitude test using materials drawn from science. The first two forms consisted of paragraphs from various fields of science, and questions based on these paragraphs; the third year the examination was divided equally into a paragraph reading test and scientific problems with multiple-choice answers. Copies of the examination questions and answers for all three years may be obtained from Science Service, 1719 N St., N.W., Washington 6, D. C.[3]

Table 1 shows the differences in the mean scores of the boys and the girls on the examination for each of the three years. The critical ratios (differences divided by their standard error) are of an order to indicate that these differences are not due to chance variations.

TABLE 1

SCORES OF BOYS AND GIRLS ON SCIENCE APTITUDE EXAMINATION

	Boys			*Girls*			*Critical ratios*
	Mean	σ	N	Mean	σ	N	
First year ..	75.3	12.2	2,460	67.5	12.9	715	14.4
Second " ..	44.9	10.8	2,507	39.0	8.8	974	16.6
Third " ..	46.7	10.5	2,021	39.7	9.2	910	18.2

The same sort of comparison will be made in the forthcoming Fourth Annual Science Talent Search and in succeeding years. In the meantime, it would appear that the decision was correct that the ratio of boys to girls among the 260 honorable mentions, and among the 40 trip winners to Washington, D. C., in each annual contest should not be equal. The proportion of boys and girls in these groups was actually based on the ratio of boys to girls who entered the contest. The fact that the 40 trip winners in the Third Annual Science Talent Search consisted of 28 boys and 12 girls, rather than half boys and half girls, probably means that a larger number of future outstanding scientists have been chosen. If 300 in the "honors group" were to be selected without reference to the proportion of girls originally completing entrance materials, it seems likely that the number of girls in this top group would be even smaller than under the present controlled system.

Thus far the sex differences in scores on the examination have been consistent each year, and they are statistically significant. They are probably due, however, to environmental and cultural factors rather than to inherent biological differences. This suggests, then, the desirability for greater attention in the primary and secondary schools to scientific training for American girls.

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[2] The selection techniques were briefly described by us in SCIENCE, 99: 319–320, April 21, 1944.

[3] The complete Science Aptitude Examination for the first year is reproduced in "Youth Looks at Science and War," Washington, D. C., Science Service, and New York, Penguin Books, 1942, pp. 110–131; and typical questions for the second year in "Science and the Future," Washington, D. C., Science Service, 1943, pp. 117–121.

REMARKS ON THE HISTORY OF SCIENCE IN RUSSIA

IN the volumes of SCIENCE a notable contribution to the appreciation of scientific progress has been the generosity of the editors in giving space for discussion of articles and correction of errors appearing in the magazine. We, the undersigned, feel obliged in the interest of truth to call upon that generosity now. We refer to the leading article in the issue of June 2, on the history and activities of the U.S.S.R. Academy of Sciences.

The story of the growth of Russian science is impressive enough without the embellishment of inaccurate and misleading assertions. The most shocking such assertion is: "However, the influence of Newtonian philosophy made no great progress in Russia at this time. In contemporary France and Germany, Newton was rapidly accepted. The cause of this neglect of Newton in the vigorous new life of Russian interest in mathematical science is not apparent. It was not until two centuries later that formal recognition of Newton become evident" (p. 440).

Mr. Frederick E. Brasch as consultant in the history of science of the Library of Congress ought to know that acceptance of Newtonian physics on the continent of Europe was not rapid but surprisingly slow. For almost fifty years after the publication of the "Principia" the leading scientific body in Europe, the Paris Academy of Sciences, still adhered to Cartesian physics and only very gradually, chiefly under

the influence of Maupertuis, Clairaut and D'Alembert, Cartesian physics gave way to Newtonian. The fact that Clairaut's "La Théorie de la Lune Déduite du Seul Principe de l'Attraction" (St. Petersburg 1752) received the prize of the Imperial Academy of St. Petersburg indicates that Newton was recognized in Russia as early as in other countries of the Continent. To say that he was not recognized there for about two centuries implies that until the twentieth century Russia had no physics, no mechanics, and no astronomy, which is clearly absurd.

As to the statement (p. 440): "Further expression of appreciation of Newton's works and influence on scientific thought is indicated by a translation in 1936 into Russian of the "Principia," first edition. . . ." If "first edition" means that the 1936 edition is the first Russian translation, that is false, because the first Russian translation was published by A. N. Kryloff in 1916. If it means translation of the first edition of the "Principia," that is false, because the translation was of the third edition.

On page 438 we find the following statement: "The University of Moscow opened in 1755, and so great was the intellectual growth among the Russian people that other cities soon established universities." This again is untrue. The first universities to be founded in Russia after Moscow were the University of Kharkov in 1804, the University of Kazan in the same year, and the University of St. Petersburg in 1819. A lapse of almost fifty years from 1755 to 1804 hardly is "soon," and it reveals that intellectual growth among the Russian people at that time was not so great as the quoted statement suggests.

Mr. Brasch also quotes from Alexander Petrunkevich of Yale University: "Applied science, such as engineering, was for a long time looked upon [in the light of special knowledge, somewhat detrimental to broad education], with the additional stigma of mistrust." It is difficult to perceive what this statement means. If it means that engineering education or the engineering profession did not have sufficient support or encouragement, the facts contradict. Russian engineering schools are among the oldest of their kind. The School of Mining Engineers was founded in 1772 and became a center of studies in geology, metallurgy and metallography. Tschernoff, whose fundamental laws (1868) form a basis for the subsequent development of metallography, was a professor of this school; so was the famous crystallographer, E. Fedoroff.

The Institute of Engineers of Ways of Communication was organized in 1807 after the pattern of the best French schools of that time. Among the professors of this school we find such names as Clapeyron (1799–1864) and Lamé (1795–1870), who were among the founders of the theory of elasticity. Perhaps due to their influence mechanics of materials and theory of elasticity always occupied an important place in the curricula of Russian engineering schools. The standards of these schools were high and it is not surprising that they produced several outstanding engineers during the second half of the nineteenth century. It suffices to mention only a few Russians whose contributions were of a fundamental nature; namely, Jouravski (*Annales des Ponts et Chaussees,* 1856); H. Golovin (*Trans. Inst. Techn. St. Petersbourg,* 1881); F. S. Jasinsky (*Annales des Ponts et Chaussees,* 1894); N. Petroff (his book "Neue Theorie der Reibung" in German translation, Leipzig, 1887).

There are other inaccuracies and misstatements in the article under discussion, which in themselves are unimportant except that a consultant in the history of science is responsible for them. For instance, Nicolas and Daniel Bernoulli were brothers, both from Basel, Switzerland, and it is inconceivable why one of them is said to be from Switzerland and the other from Germany. Neither of them was a professor of mathematics, as this article says, before coming to the Academy of St. Petersburg. Nicolas occupied the chair of jurisprudence in Bern at the time he was called to St. Petersburg, while his younger brother Daniel, by profession a physician, did not hold any professorial position at all, either in Germany or in Switzerland, when he was called to the Academy. Leonhard Euler, pride of the Russian Academy, was not called to St. Petersburg until 1727 to fill the vacancy left by the untimely death of Nicolas Bernoulli. Chretien Goldbach, a quite insignificant mathematician, never was a member of the Academy of Sciences (refer to page 437).

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SCIENTIFIC BOOKS

FATTY ACIDS AND LIPIDS

The Biochemistry of the Fatty Acids, and their Compounds, the Lipids. By W. R. BLOOR. A.C.S. Monograph Series, 377 pp. New York: Reinhold Publishing Corporation. 1943.

THE author of this monograph has devoted the past thirty-five years to the study of the lipids. By virtue of both seniority in the field and the importance of his original contributions, he is recognized as the dean of lipid biochemists. He has systematically followed and

catalogued the results of the researches of others. No one, therefore, could have been better qualified by thorough familiarity with the subject to write this long-needed review of existing information concerning the biochemistry of the fatty acids and their compounds, the lipids.

In preparing to write the book, Dr. Bloor evidently realized that it should fulfil two purposes: to provide the general student of biochemistry with a present-day interpretation of the chemistry of the lipids and their rôle in the functioning of living matter; and to provide the present and future researcher in the lipid field with a complete and convenient catalogue of the information that has accumulated about the lipids. The subject is dealt with in six chapters: Chemistry; Digestion and Absorption; Lipids of the Blood; the Lipids of Tissues; Lipid Metabolism; and the Lipids of Secretions and Excretions. Each chapter in turn is subdivided into numerous sections and subsections, each of which is indicated in the exceptionally detailed table of contents. Thus the reader is provided with a key to the information on any specific subject concerning the lipids. Each chapter ends with a complete and conveniently indexed bibliography which enables one to consult the original sources of the information summarized in the book. In spite of the author's admission of the incompleteness of his bibliography, the literature on the lipids up to about 1940 appears to be pretty thoroughly catalogued. Although the preface was written in April, 1943, it is evident that most of the information published since about 1940 is either missing or is very briefly mentioned. It is of course inevitable in any review of a rapidly advancing field that recent findings, many of which necessitate a radical change in viewpoint or interpretation, are omitted. Such is the case with Dr. Bloor's monograph. In general the important and far-reaching results that have been obtained by the use of the isotopes are not included. Consequently, in the reviewer's opinion at least, certain of the interpretations of earlier data are either untenable or at any rate inadvisable as definite statements of fact. For the research worker in the lipid field such faults are of little importance; they serve to accentuate the need for further work and especially for new methods of approach. The general reader, on the other Land, is likely to be left with falsely secure convictions concerning certain aspects of the biochemistry of the lipids.

"The Biochemistry of the Fatty Acids and the Lipids" is treated by Dr. Bloor primarily from a physiological standpoint. The balance between the more strictly chemical, *i.e.*, the organic and physico-chemical aspects, and the functional is perhaps not as even as some would wish. Chapter I, dealing with the chemistry of the fatty acids and the lipids, takes up only the first fifty-seven pages of the total three hundred and seventy-seven; of these fifty-seven, twenty deal with quantitative methods. Furthermore, Chapter I suffers perhaps more than the other chapters from the absence of the more recent work. For example, the chemistry of the material conventionally called cephalin has been considerably modified and elucidated by the work of Folch: cephalin is a mixture of at least three components.

In the remaining chapters the author has done an admirable job of classifying the enormous amount of information, and by intercalating introductory remarks, interpretations and summaries, of weaving the various threads into a fabric. As stated in his preface, Dr. Bloor himself has recognized that this fabric is imperfect; it can not be otherwise in a growing subject. Nevertheless, the monograph will fill a long-felt need and will serve as a very useful guide to further constructive research into the biochemistry of the lipids.

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SYNTHETIC SUBSTANCES

The Chemistry of Synthetic Substances. By DR. EMIL DREHER. Translated by MARION LEE TAYLOR. 103 pp. New York: Philosophical Library. 1943. $3.00.

THE original of this volume appeared in German in 1939 at a time when the chemistry of large molecules had not received the attention which is at present devoted to it. The effects of constituents and substituents on the polymerization and the properties of the resultant condensates had not received the published discussion which is at present available.

At that time, Dr. Dreher's volume made a notable contribution to this difficult subject and all the information contained in the volume is still of basic importance. The available copies of the first German edition were very limited in number and the present translation will therefore be welcome to those who either were unable to secure the German or were unaware of its existence.

The volume discusses high molecular organic compounds and the principles of the processes of polymerization and polycondensation. Several chapters are devoted to the influence of side groups on the capacity for polymerization, and a chapter is devoted

to the solubility of high molecular film-forming substances.

The book from start to finish is strictly chemical and the approach to all the subjects is, as the title implies, a study of the chemistry of the processes under discussion. It is replete with bibliographic references inserted at the ends of the various chapters.

The style of the translator is somewhat influenced by an occasional too literal translation of the German, and the general format reveals the influence of the modern requirements of our war economy. The book should be a valuable addition to the libraries of all those who are interested in the chemistry of polymerization and will be particularly welcome to those who have seen the German original and have wished for an English translation.

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MARINE AND AIR NAVIGATION

Marine and Air Navigation. By JOHN Q. STEWART and NEWTON L. PIERCE. 472 pages. Ginn and Company. $4.50.

ALTHOUGH the difference between marine and air navigation is largely one of technique, this is probably the first text to treat both equally. Many students will want to read both parts, yet the reader who wishes to limit his studies to either one will find the two sufficiently well separated to permit this.

The book contains a large number of illustrations and reproductions of charts and government publications. Throughout the book emphasis is given practice rather than theory, with mathematics playing a supporting role and never a leading one. The book is unusually readable for a text and for piloting and dead reckoning navigation is thorough and well organized.

The only fault, if it is one, is the order of presentation of the various parts of celestial navigation. A step-by-step explanation of the simplest method of solution of celestial observations is all that is necessary for the navigator with modern equipment, but it may not be the best way to instill a thorough understanding of the principles which may be needed when the easiest tools are not available.

Despite this feature, which many readers will entirely approve, the book is easily the best general text on navigation that has appeared in recent years.

Basic Marine Navigation. By BART J. BOK and FRANCES W. WRIGHT. 422 pp. Houghton Mifflin Company. Book, $4.50; kit, $1.70.

WRITTEN for the Army Engineer Command, this book gives chief attention to navigation near land. Emphasis is given procedure, and where rules and computational forms suffice, a deeper discussion is omitted. It attempts to develop "an intuitional understanding of the procedures" rather than a theoretical understanding of the principles involved. Included is an interesting and practical chapter on "Navigation in Emergencies," a good chapter on "Marine Meteorology" and one on the principles of the maneuvering board.

Celestial navigation is fully covered, but the chapter on the sextant seems to be out of place and "Navigation by the Sun" and "Navigation by the Stars" are separated as though there were an essential difference between them. Somewhat questionable, also, is the placing of special cases before the usual method of finding a line of position.

Regardless of its weaknesses, this is one of the better recent books on navigation. It is well written and contains a number of excellent illustrations. It is particularly recommended to the person who wants to teach himself. Available separately is a "kit" which supplies the necessary materials for solving the practice problems of the text.

The Theory of the Gyroscopic Compass and Its Deviations. By A. L. RAWLINGS. 182 pp. The Macmillan Company. $3.00.

IN this second edition the author has simplified the mathematics somewhat, but it is still too involved for the average reader.

The book naturally falls into three parts, the first dealing with the principle of the gyroscope, the second giving a description of the various gyro-compasses; the third dealing with the errors of the gyro-compass, as an instrument to indicate true north, and their solution.

Written from the viewpoint of the designer, the book contains much of interest to the non-mathematical reader with a general knowledge of the instrument. It is undoubtedly the most thorough book on the subject.

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SPECIAL ARTICLES

A METHOD OF PROLONGING THE ACTION OF PENICILLIN[1]

THE clinical effectiveness of penicillin has been well established. However, from the standpoint of determining optimum dose, period of time necessary for treatment and of inconvenience both to patient and

[1] From the Penicillin Section, Laboratory Service, Walter Reed General Hospital. The technical assistance of

personnel, present methods[2, 3, 4, 5, 6] of administration are not completely satisfactory.

In this study a method of administration of penicillin is reported which decreases the rate of absorption, prolongs the duration of an effective level in the blood and is of minimum inconvenience to the patient.

Beeswax has been used to prolong the action of histamine,[7] desoxycorticosterone acetate[8] and heparin.[9] rabbits after intramuscular injections. More enduring levels resulted than occur with penicillin in physiological saline, but a greater prolongation was desirable.

Under sterile conditions, 0.75 per cent., 1.0 per cent., 1.25 per cent., 2.0 per cent., 3.0 per cent., 4.0 per cent., 5.0 per cent. and 6.0 per cent. mixtures of U.S.P. bleached beeswax in peanut oil were prepared.

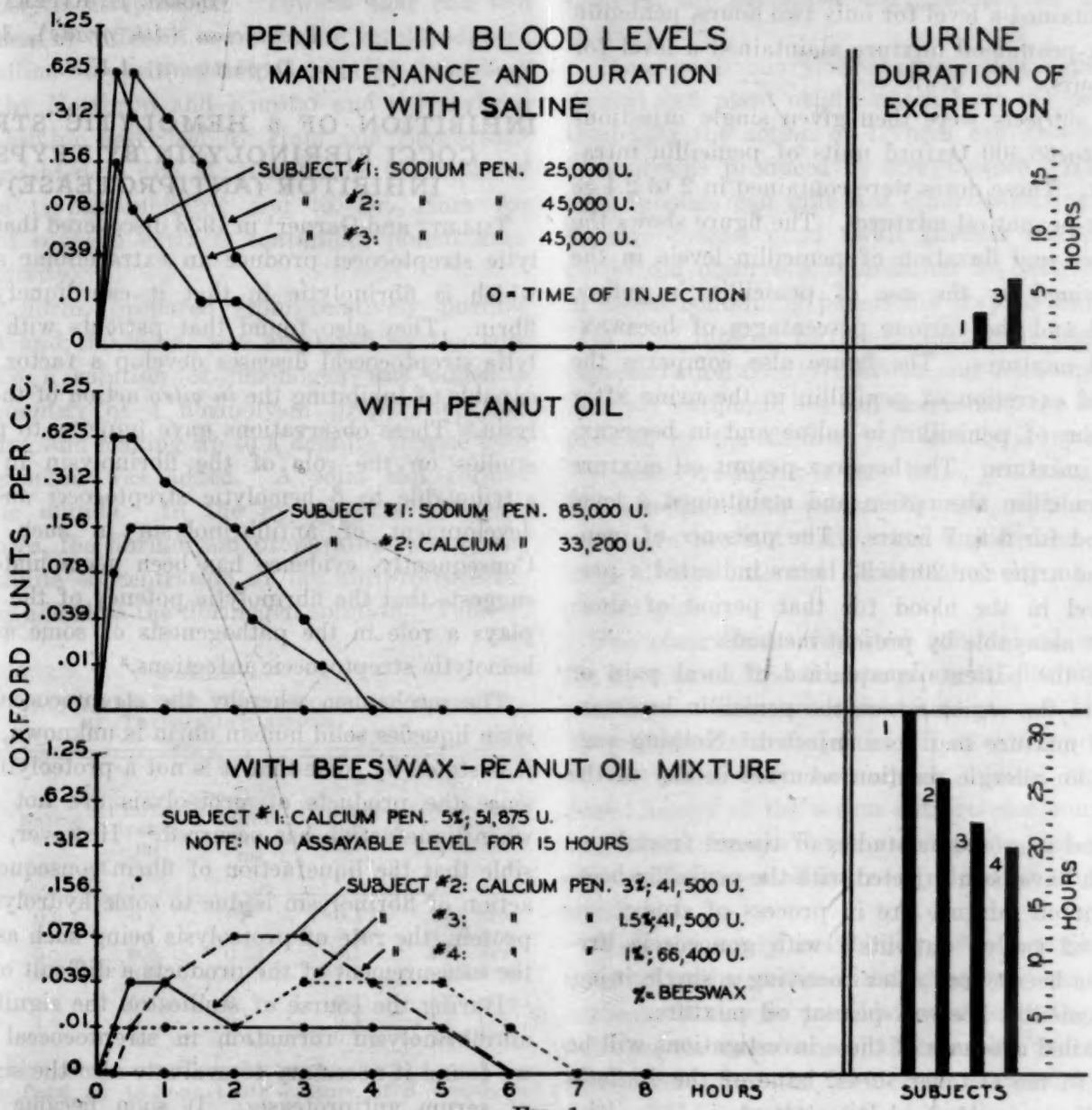

FIG. 1

Prior to the utilization of beeswax, in February, 1944, we had suspended penicillin in refined peanut oil, sesame oil, cottonseed oil, castor oil and protamine zinc in an attempt to produce prolonged action in Two to 3 cc of the clear warmed beeswax-peanut oil mixture were added with a warm pipette to an ampule of penicillin which had previously been shaken by hand to break the penicillin into as powdery a state as possible. Three to 5 sterile glass beads were then placed in the bottle which was stoppered and shaken by hand for ten to fifteen minutes until the particles of penicillin were well dispersed.

Miss Dorothy Talbot and Technician (4th grade) Minna Levy is gratefully acknowledged.

[2] H. Dawson and G. V. Hobby, *Jour. Am. Med. Asn.*, 124: 611, March 4, 1944.

[3] W. E. Herrell, *Jour. Am. Med. Asn.*, 124: 622, March 4, 1944.

[4] A. L. Bloomfield, L. A. Rantz and W. M. Kirby, *Jour. Am. Med. Asn.*, 124: 627, March 4, 1944.

[5] H. V. Morgan, R. V. Christie and I. A. Roxburgh, *Brit. Med. Jour.*, 515: April 15, 1944.

[6] Unpublished data on observation of 250 cases treated with penicillin at Walter Reed General Hospital.

[7] C. F. Code and R. L. Varco, *Am. Jour. Physiol.*, 137: 225–233, August, 1942.

[8] C. F. Code, R. H. Gregory, R. E. Lewis and F. J. Kottke, *Am. Jour. Physiol.*, 133: 240–241, June, 1941.

[9] J. C. Bryson and C. F. Code, *Proc. of Staff Meeting, Mayo Clinic*, 19: 100, February 23, 1944.

Stability tests[10] on the penicillin in oil and in beeswax-peanut oil mixture show no deterioration in various batches kept at refrigerator, room and 37 degrees C. temperature for 30 to 62 days.

As initial experiments rabbits were injected intramuscularly with 5,000 to 10,000 Oxford units of penicillin contained in 1 cc of beeswax-peanut oil mixture and blood assays[11] were made. Whereas penicillin in saline maintained a level for only two hours, penicillin in beeswax-peanut oil mixture maintained a level for 6 to 12 hours.

Human subjects were then given single injections of 41,500 to 66,400 Oxford units of penicillin intramuscularly. These doses were contained in 2 to 2.4 cc of beeswax-peanut oil mixtures. The figure shows the maintenance and duration of penicillin levels in the blood obtained by the use of penicillin in saline, peanut oil and the various percentages of beeswax-peanut oil mixtures. The figure also compares the duration of excretion of penicillin in the urine after the injection of penicillin in saline and in beeswax-peanut oil mixture. The beeswax-peanut oil mixture delayed penicillin absorption and maintained a level in the blood for 6 to 7 hours. The presence of penicillin in the urine for 20 to 32 hours indicated a persisting level in the blood for that period of time, though not assayable by present methods.

None of the patients complained of local pain or irritation in the region where the penicillin beeswax-peanut oil mixture had been injected. Nothing suggestive of an allergic reaction occurred in any of the subjects.

Gross and microscopic studies of tissues from hamsters which have been injected with the penicillin beeswax-peanut oil mixture are in process of study.

Eleven of twelve patients[13] with gonococcic urethritis have been cured after receiving a single injection of penicillin beeswax-peanut oil mixture.

The detailed accounts of these investigations will be published in the October, 1944, issue of the *Bulletin* of the U. S. Army Medical Department.

Summary

(1) Single injections of penicillin in beeswax-peanut oil mixture will produce and maintain levels of penicillin in the blood for 7 or more hours.

(2) These mixtures have maintained their potency at room, incubator and refrigerator temperatures for 30 to 62 days and show no signs of deterioration to date.

(3) Eleven of twelve patients with gonorrhoea have been cured by a single injection of penicillin beeswax-peanut oil mixture.[14]

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[10] Assays were made by the methods of Rammelkamp[11] and Rake.[12] Penicillin assays of the urine were also done by these methods.

[11] C. H. Rammelkamp, *Proc. Soc. Exp. Biol. and Med.*, 51: 95, October, 1942.

[12] G. Rake and H. Jones, *Proc. Soc. Exp. Biol. and Med.*, 54: 189, 1943.

[13] The cooperation of Captain Robert J. Murphy of the V.D. Ward is appreciated.

[14] An additional fifty-three cases have been cured by this method. Data on these cases will be published later with Captain Robert J. Murphy.

INHIBITION OF β HEMOLYTIC STREPTOCOCCI FIBRINOLYSIN BY TRYPSIN INHIBITOR (ANTIPROTEASE)*

TILLETT and Garner[1] in 1933 discovered that β hemolytic streptococci produce an extracellular substance which is fibrinolytic in that it can liquefy human fibrin. They also found that patients with β hemolytic streptococcal diseases develop a factor which is capable of inhibiting the *in vitro* action of the fibrinolysin. These observations gave impetus to numerous studies on the role of the fibrinolysin in diseases attributable to β hemolytic streptococci and on the development of antifibrinolysin in such patients. Consequently, evidence has been accumulated which suggests that the fibrinolytic potency of the organism plays a role in the pathogenesis of some aspects of hemolytic streptococcic infections.[2]

The mechanism whereby the streptococcal fibrinolysin liquefies solid human fibrin is unknown, although it is stated by some that it is not a proteolytic enzyme since the products of proteolysis are not apparent when liquefaction has occurred.[2] However, it is possible that the liquefaction of fibrin consequent to the action of fibrinolysin is due to some hydrolysis of the protein, the rate of proteolysis being such as to make the measurement of the products a difficult one.

During the course of studies on the significance of antifibrinolysin formation in streptococcal diseases, we found it necessary to evaluate also the significance of serum antiproteases. It soon became apparent that a serum which has a high antifibrinolysin titer also has a high antiprotease (antitrypsin) titer. This lent emphasis to the possibility that the two phenomena are related and consequently, that the streptococcal fibrinolysin is more closely related to proteases than hitherto believed. It is probable that the proper application of Bergmann's method[3] would

[14] An additional fifty-three cases have been cured by this method. Data on these cases will be published later with Captain Robert J. Murphy.

* From the AAF Rheumatic Fever Control Program.

[1] W. S. Tillett and R. L. Garner, *Jour. Expt. Med.*, 58: 485, 1933.

[2] W. D. Tillett, *Bact. Rev.*, 2: 161, 1938.

[3] M. Bergmann, "Advances in Enzymology," 1: 63, 1941.

elucidate the relationship of the fibrinolysin to some specific protease. However, our facilities prevented the application of such procedures and therefore other experiments were designed.

Since we observed a close relationship between the serum antiprotease and antifibrinolysin, we decided to test the effect of substances with known anti-tryptic properties on the action of the fibrinolysin secreted by β hemolytic streptococci. Toward that end two antiproteases of different sources were employed, *viz.*, the crystalline "trypsin-inhibitor" isolated from beef pancreas by Northrop and Kunitz[4] and the soybean trypsin-inhibitor described by Ham and Sandstedt.[5] We are indebted to Dr. M. Kunitz for a sample of crystalline trypsin-inhibitor and to Dr. Ham for samples of soybean extracts containing potent anti-tryptic activity.

Human fibrin, prepared from relatively purified fibrinogen and thrombin, was employed as the substrate. To a solution of fibrinogen was added a definite quantity of a fibrinolysin preparation and after mixing and making up to a definite volume with saline, thrombin was added. A solid clot formed within one minute. In the experiments with the antiproteases, the fibrinolysin preparation was mixed with a definite concentration of the antiprotease before it was added to the fibrinogen solution. Table 1,

TABLE 1

INHIBITION OF β HEMOLYTIC STREPTOCOCCUS FIBRINOLYSIN BY TRYPSIN-INHIBITORS

	Fibrinogen solution (1 per cent.) ml	Saline ml	Fibrinolysin* ml	Trypsin inhibitor ml	Thrombin ml	Time for liquefaction
A	0.25	0.5	0.5	0	0.1	39 min.
	0.25	1.0	0	0	0.1	40.5 hrs.
	0.25	0	0.5	0.5†	0.1	63 hrs.
	0.25	0.4	0.5	0.1†	0.1	3.5 hrs.
B	0.25	0.5	0.5	0	0.1	43 min.
	0.25	1.0	0	0	0.1	+24 hrs.
	0.25	0	0.5	0.5‡	0.1	+24 hrs.

* Filtrate from an 18-hour broth culture of β hemolytic streptococci.
† 5 mgm crystalline trypsin inhibitor per ml (Northrop and Kunitz).
‡ Soybean extract (Ham and Sandstedt).

illustrative of many similar experiments, reveals that crystalline trypsin-inhibitor of pancreatic origin (A) and crude soybean extract with potent anti-trypsin activity (B) completely inhibit the action of a β hemolytic streptococcal fibrinolysin. The potency of the antiproteases was tested by noting their ability to inhibit pancreatic trypsin. Of interest is the fact that the trypsin inhibitors not only inhibited the streptococcal fibrinolysin but, in sufficiently high concentrations, also inhibited the spontaneous lysis of the fibrin which in turn is due presumably to a non-bacterial fibrinolysin.

It made little difference as to how the fibrinolysin was prepared. Thus, similar results were obtained with the whole 18-hour streptococcal cultures, filtrates of such cultures and the alcoholic precipitates of such filtrates, all of which were of proven fibrinolytic potency.

These preliminary data reveal that substances of animal and plant origin which have the property of inhibiting the action of trypsin can also inhibit the fibrinolysins produced by streptococci. Whether the antiproteases can influence other exotoxins produced by streptococci must await further studies, though Grob[6] did observe a retardation of bacterial growth in media containing pancreatic trypsin-inhibitor.

It is of interest in this connection to note Netter's demonstration that tyrothricin and actinomycin A are not only antibiotic but can also inhibit the fibrinolysin present in the filtrates of hemolytic streptococci.[7] Whereas tyrothricin is very toxic, preliminary studies indicate that both pancreatic and soybean trypsin-inhibitors are not toxic when injected in relatively large dosage into the peritoneal cavity of mice and guinea pigs.

The observations reported herein lend support to the hypothesis that the streptococcal fibrinolysins are proteolytic enzymes which are related to trypsin. They suggest also that the antiprotease concentrations of the blood may have much clinical significance. Serial assays of the serum antiprotease concentration in various diseases lends emphasis to this possibility and will be reported in greater detail in another communication.

With the ready availability of non-toxic preparations of antiproteases either from pancreas or from soybeans it may be possible to influence the course of β hemolytic streptococcal diseases by preventing the *in vivo* effects of the fibrinolysin secreted by the bacteria. This and other clinical applications of trypsin-inhibitors (antiprotease) in various disease states are now under investigation.

SUMMARY

Crystalline "trypsin-inhibitor" of pancreatic origin and the antitrypsin of soybean origin completely inhibit the fibrinolytic activity of cultures of β hemolytic streptococci, of filtrates of such cultures and of concentrates of such filtrates. It is suggested that the streptococcal fibrinolysin is a protease and that it may be related to trypsin.

[4] J. H. Northrop and M. Kunitz, *Jour. Gen. Physiol.*, 6: 267, 1932–33.
[5] W. D. Ham and R. M. Sandstedt, *Jour. Biol. Chem.*, 154: 505, 1944.
[6] D. Grob, *Jour. Gen. Physiol.*, 26: 431, 1943.
[7] E. Netter, *Proc. Soc. Exp. Biol. and Med.*, 49: 163, 1942.

The author wishes to acknowledge gratefully the cooperation of Lieutenant Colonel Robert L. King, Lieutenant Colonel E. D. Embree and Captain Edward Freis.

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EFFECT OF SPINAL FLUID FROM PATIENTS WITH MYASTHENIA GRAVIS ON THE SYNTHESIS OF ACETYLCHOLINE IN VITRO[1, 2]

IT was found that less acetylcholine was synthesized in the presence of serum from patients with myasthenia gravis than serum from healthy persons or patients with diseases other than myasthenia gravis.[3, 4] Some of the factors modifying the synthesis of acetylcholine seem to be of relatively small molecular size, since they pass through a semipermeable Cellophane membrane.[4] To ascertain whether these factors are able to pass into the spinal fluid the effect of spinal fluid of patients with myasthenia gravis and of control subjects on the synthesis of acetylcholine *in vitro* was investigated.

METHOD

The amount of synthesis of acetylcholine was ascertained using an adaptation[4] of the method of Quastel, Tennenbaum and Wheatley.[5] The spinal fluid was assayed immediately after collection. The pH of the spinal fluids was adjusted to 7.4. One cc of spinal fluid was added to a mixture containing minced frog brain (100 mg), Ringer's solution (2 cc) at pH 7.4, physostigmine salicylate (3 mg) and glucose (4.8 mg). The mixtures were shaken and incubated aerobically at 37° C for 4 hours and the amount of free and total acetylcholine synthesized was assayed biologically, using the sensitized rectus abdominis muscle of frog.

RESULTS

The effects of spinal fluid of 3 patients with myasthenia gravis and 25 control subjects were studied. The clinical states of the patients with myasthenia gravis are summarized in Table 1. The control subjects were patients with convulsions, fits, displaced intervertebral disks, headaches, brain tumors or were suspected of having brain tumor.

TABLE 1

SHORT SUMMARY OF THE CLINICAL STATE OF THE PATIENTS WITH MYASTHENIA GRAVIS

Name	Sex	Age	Severity of disease	Duration (yrs)	X-ray treatment	Thymectomy	Symptomatology	Neostigmine (Prostigmine Bromide Hoffmann-LaRoche)	
								Dose mg/day	Achievement after medication
R	F	23	3+	9	yes	no	moderate lid ptosis, occasional diplopia, occasional difficulty in chewing and swallowing, moderate muscular fatiguability	90	Walks 1–2 blocks
Sa	F	32	3+	7	no	no	moderate lid ptosis, occasional diplopia, occasional difficulty in chewing, moderate muscular fatiguability	90–150	housework
P	M	36	2+	2	no	no	difficulty in chewing, moderate muscular fatiguability	45–75	Walks, but unable to work

The amounts of acetylcholine synthesized in the various mixtures are summarized in Table 2. In the presence of spinal fluid an average of 50 per cent. more acetylcholine was synthesized than in the presence of serum from the same subject. This observation suggests that at least some of the factors increasing the synthesis of acetylcholine pass into the spinal fluid. Less acetylcholine was synthesized in the presence of spinal fluid from patients with myasthenia gravis than with spinal fluid from the control subjects. The percentage defect in the synthesis of acetylcholine in the presence of spinal fluid from the patients with

TABLE 2

AMOUNTS OF ACETYLCHOLINE SYNTHESIZED IN THE PRESENCE OF SPINAL FLUID FROM PATIENTS WITH MYASTHENIA GRAVIS AND CONTROL SUBJECTS

Subject	Average of acetylcholine synthesized			
	Free acetylcholine in µg per 100 mg frog brain	Per cent. of control	Total acetylcholine in µg per 100 mg frog brain	Per cent. of control
Controls	2.11 ± 0.053		3.16 ± 0.049	
Patients with myasthenia gravis				
R	1.21 ± 0.025	57	1.87 ± 0.032	59
Sa	1.27 ± 0.025	60	2.00 ± 0.037	62
P	1.41 ± 0.029	67	2.20 ± 0.040	69

[1] This study was aided by a grant from the Josiah Macy Jr. Foundation.

[2] From the New York Hospital and the Departments of Medicine (Neurology) and Psychiatry, Cornell University Medical College, New York, N. Y.

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[4] C. Torda and H. G. Wolff, in press, *Jour. Clin. Invest.*, September, 1944.

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myasthenia gravis was about the same as the percentage defect in the synthesis of acetylcholine in the presence of serum from the same patient.[4]

DISCUSSION

H. C. Stoerk and E. Morpeth,[6] using rat brain as a source of the enzyme, found the same amount of acetylcholine synthesized in the presence of serum from patients with myasthenia gravis as in the presence of serum from control subjects. Since they also were unable to demonstrate any difference in the amounts of acetylcholine synthesized in the presence of serum from control subjects as compared to Locke's solution, it would appear as though their adaptation of the method of Quastel, Tennenbaum and Wheatley, using rat brain, is not sensitive enough to demonstrate slight differences in the synthesis of acetylcholine due to the presence or absence of substances in the serum of patients with myasthenia gravis. This lack of sensitivity is probably due in the main to the greater lability and the relatively lower concentration of the enzyme and to the chemical properties of the substances contained in the rat brain.

SUMMARY

Human spinal fluid is a more favorable medium to further the synthesis of acetylcholine *in vitro*, using enzyme obtained from frog brain, than is serum. Also, since less acetylcholine was synthesized in the presence of spinal fluid from patients with myasthenia gravis than spinal fluid of control subjects, it is probable that at least some of the factors responsible for the decrease and increase of the synthesis of acetylcholine pass into the spinal fluid.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE MEASUREMENT OF "FOLIC ACID"

DURING the past few years we have been interested in measuring the "folic acid" activity of the liver concentrates which we have been using in animal experiments. Both the *Streptococcus lactis* R and *Lactobacillus casei* e methods have been used[1, 2, 3] and certain improvements have been made in each case.[4, 5] However, many difficulties are still encountered in any attempt to express the activity of a given preparation so that results in different laboratories may be compared. We have found Table 1 to be useful in comparing the results of different workers, and we hope it may be useful to others.

The columns in the table labeled "½ maximum" indicate the approximate number of micrograms of material which provides one half of the maximum growth (as measured by turbidity) or acid production (as measured by titration) per 10 ml of complete medium. Although rather large differences may occur between the turbidimetric and titrimetric methods, these val-

TABLE 1

Material	Source	Investigator	S. lactis R ½ maximum	S. lactis R Potency	L. casei e ½ maximum	L. casei e Potency
			ug.		ug.	
1. Lederle crystals	Liver	Stokstad[6]	.0025	78,000	.00055	79,000
2. Lederle crystals	Yeast	Stokstad[6]	.005	38,000	.0005	75,000
3. Lederle crystals	?	Hutchings[7] *et al.*	.042	5,000	.00061	70,000
		Luckey[4]	.05	2,000	.0035	10,000
		Teply[5]	.1	3,500	.0012	13,000
4. Parke Davis crystals (B_c)	Liver	Pfiffner[8] *et al.*			.0005	
		Luckey	.0013	77,000	.0013	27,000
		Teply	.004	88,000	.0004	40,000
5. Merck crystals	?	Keresztesy[9] *et al.*		*		*
6. Texas preparation A	Spinach	Luckey	.004	25,000	.002	21,000
Texas preparation B	Spinach	Teply	.027	13,000	.0027	6,000
7. Thymine	Synthetic	Luckey	2	50	4	9
8. Solubilized liver	Pork	Luckey	100	1	35	1
		Teply	350	1	16	1
9. Liver fraction B	Pork	Texas group		1		1
		Stokstad (calculated)	200	1	40	1
		Luckey	90	1	70	.5

* Potency for this material is unpublished; however, calculations from footnote 9 indicate it to be 140,000 times as active for *Streptococcus lactis* R as for *Lactobacillus casei* e.

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ues are more reliable than the values listed under "potency," since "potency" values depend upon one more variable, that of the initial standard. "Potency" values express the number of times more active a substance is than the standard (potency 1) and are useful to compare the results of different methods of assay. The "½ maximum" values for solubilized liver obtained in the turbidimetric method of Luckey vary considerably from those obtained in the titrimetric method of Teply, but the potency values obtained when solubilized liver is used as the standard agree quite well.

Methods of designating "folic acid" activity which have been used are:

(1) Snell-Peterson unit[1]: The weight of sample needed to produce one half maximum growth or fermentation in 10 ml of a defined medium.

(2) The empirical method[2]: Amount of "folic acid" (potency 40,000). (When this method was inaugurated the Texas group estimated the pure "folic acid" should be 40,000 times as active as their standard.)

(3) Williams milligram unit[10, 11]: The number of milligrams of material of potency 40,000.

(4) Snell milligram unit[12]: This unit is based upon one milligram of the standard (potency 1).

(5) Per cent. purity[9]: This method is based upon material of 40,000 potency arbitrarily set as pure.

(6) Per cent. activity[13]: The activities of the sample and the standard are compared on a percentage basis.

(7) Direct method: Equivalent weight of a crystalline standard. Only an equivalent weight can be expressed since a given sample may contain more than one compound in the folic acid group.

The existence of these various standards, methods and units indicates the need for establishing a uniform procedure for measuring "folic acid" activity.

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AN INEXPENSIVE DECOMPRESSION CHAMBER

WITH the increasing interest in recent years in problems of aeronautics, no doubt many attempts to investigate problems in this field would be undertaken if a decompression chamber were available. It has been our experience that very satisfactory work can be done in this regard with an old type bed sterilizer still attached to a steamline.

The sterilizer we have access to is manufactured by the American Sterilizer Company, rectangular in shape with inside dimensions of 36″ × 42″ × 84″. By disconnecting, for safety's sake, all the steamlines and valves to the chamber with the exception of the one leading past the evacuation valve connected to the inside of the chamber, we contrived a simple but effective decompression chamber which can be evacuated at such a rate that an altitude equivalent to 35,000 feet can be reached in 12 minutes. By adjusting the evacuation valve, any desired altitude below 35,000 feet can be maintained for several hours without any appreciable fluctuation.

To make an observation window or opening through which light, telephone cords or oxygen lines could pass, holes were drilled in one of the doors and sealed with screw caps and plates so that any necessary change for future experimentation could conveniently be made. Up to the present time we have used our chamber to take x-ray pictures of the gastrointestinal tract of dogs at various altitudes and to record various sensations in man when taken to high altitudes.

By removing the x-ray tube we have found that two subjects, and if necessary three, can quite comfortably sit in the chamber at one time. By using an electric fan in the chamber and circulating a constant stream of water through the outside jacket of the chamber, the subjects within the chamber remain quite comfortable. Under these conditions, going to and from altitudes of approximately 30,000 feet, the temperature does not vary more than 6° F. and the relative humidity remains between 62 and 65 per cent.

This type of chamber is easily and cheaply equipped and is adaptable for various types of short- or long-time experiments. This, along with the fact that the chamber can at any time be reconverted to what it was originally used for, commends it for more extensive use.

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